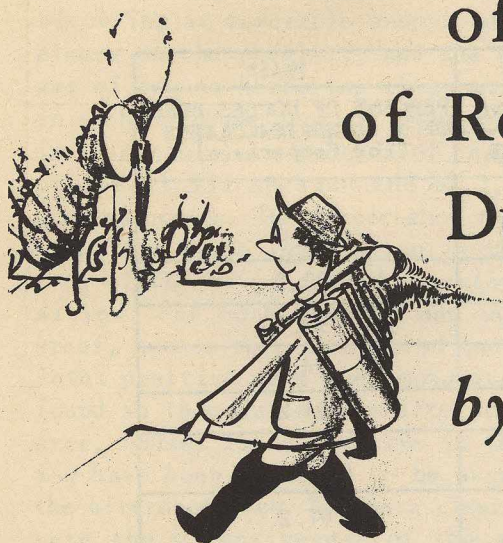


ENTOMOLOGICAL EVALUATIONS of Results of Residual DDT Spraying During 1946*



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During the 1946 season the Communicable Disease Center of the U. S. Public Health Service, in cooperation with State Health Departments in the Southern States continued and expanded the Extended Program for malaria control which was begun during 1945. This program consists principally of the spraying of DDT in houses to control malaria in the more important endemic areas of the South, and to meet the threat of increased malaria transmission occasioned by the return of service personnel who contracted the disease overseas. During 1945 the houses and privies on some 40,000 premises were given one or more treatments with DDT emulsion applied at the rate of 100 mg. of DDT per square foot. Over 750,000 houses in 266 counties of 13 states were treated during the 1946 season with a similar number of residual applications of DDT. In 1946, however, the DDT application rate was doubled, that is, 200 mg. were applied per square foot in an effort to secure a longer lasting residual effect and thereby decrease the frequency of application.

The results of this work were measured by entomological criteria. These measurements were of two types:

1. A small percentage of houses selected at random in sprayed areas was inspected to determine the results of the spray in keeping houses free of resting *A. quadrimaculatus*. At the time of each house inspection, the number of *quadrimaculatus* in an adjacent favorable resting place also was determined to obtain a general index to mosquito abundance on the premises. Barns were used principally for the latter purpose. A number of similar house and outbuilding examinations also were made in unsprayed areas for comparison.

2. Precipitin tests were made of blood from engorged specimens of *quadrimaculatus* collected from sprayed and unsprayed areas in order to determine the effect of the spray in reducing the numbers of mosquitoes which feed on man and persist about premises. This method of evaluating results is based on the supposition that *quadrimaculatus* feeds on man principally while indoors. If the spray is having the desired effect in killing these human feeders, the *quadrimaculatus* population about sprayed premises should contain fewer human-fed specimens than is the case normally.

Table I summarizes the results of the

* In the preceding paper by Dr. Link, available data on the effect of the DDT residual spray in reducing malaria have been presented and discussed. It is the purpose of this paper to present some of the results of the work as measured by entomological criteria.

Table I

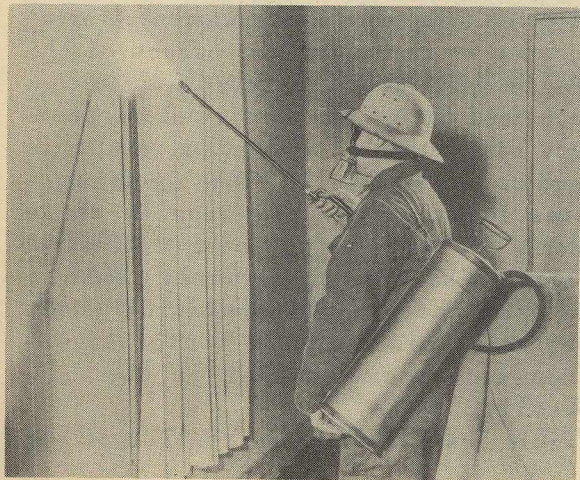
HOUSE INSPECTIONS ON RESIDUAL SPRAY PROGRAM. TOTAL TREATED HOUSES INSPECTED AND PERCENT FREE OF *A. QUADRIMACULATUS* IN AFTERNOON.

| MONTHS AFTER SPRAYING | NUMBER HOUSES INSPECTED | 1946 | | 1945* |
|-----------------------|-------------------------|--------------------------------|---------|--|
| | | HOUSES FREE OF <i>A. QUAD.</i> | PERCENT | PERCENT OF HOUSES FREE OF <i>A. QUADRIMACULATUS</i> (For Comparison) |
| 1 | 6,018 | 5,969 | 99.19 | 98.9 |
| 1 - 2 | 6,739 | 6,673 | 99.02 | 98.3 |
| 2 - 3 | 5,321 | 5,271 | 99.06 | 95.7 |
| 3 - 4 | 2,974 | 2,935 | 98.22 | 94.7 |
| 4 - | 899 | 883 | 98.22 | 94.2 |
| TOTAL | 21,951 | 21,731 | | |
| PERCENT | | | 99.00 | 97.2 |

* Bradley, G.H., and Fritz, Roy F. 1946. Entomological evaluation of DDT residual spraying for malaria control. Journ. Nat'l Malaria Soc. 5: 141-145.

1946 spraying operations in keeping houses free of resting anophelines. Of 6,018 houses inspected up to one month after spraying, only 49 or 0.81 percent contained anophelines; thus 99.19 percent of the treated houses were found to be free of these mosquitoes. At intervals of 1 to 2, 2 to 3, 3 to 4, and over 4 months, after spraying, the percentages

Premise spraying inside homes and other buildings is the principal method used in the Extended Malaria Control Program.



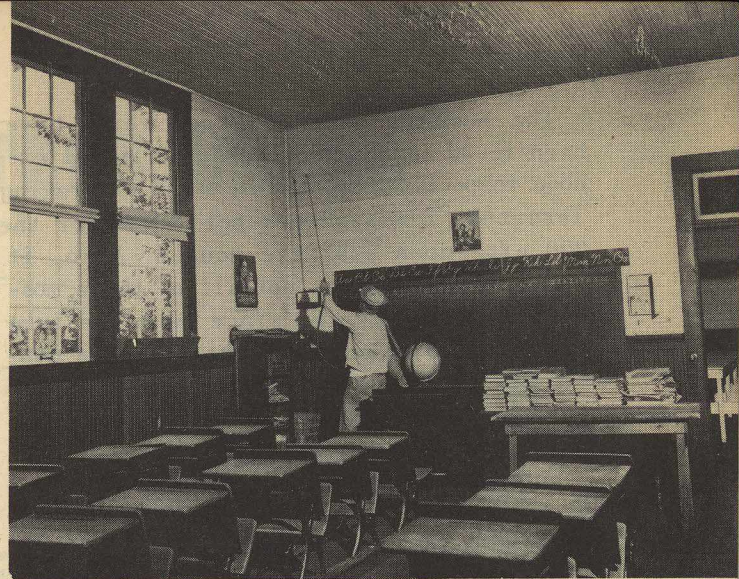
of sprayed houses with mosquitoes increased slightly, but even after 4 months *A. quadrimaculatus* was found in only 1.78 percent of the sprayed houses. For comparison, the percentages of *quadrimaculatus*-positive houses at similar intervals after spraying during the 1945 season are shown in table I. As has been stated, an application of only 100 mg. DDT per square foot was used during 1945, while the 1946 application rate was 200 mg. per square foot. The effect of the heavier dosage in increasing the duration of spray effectiveness is clearly indicated by the smaller percentages of *quadrimaculatus*-positive houses occurring in each spray-age group during 1946. In all, 21,951 sprayed houses were inspected during 1946, of which only approximately 1 percent was found to contain mosquitoes. This compares with 2.8 percent of sprayed houses positive for mosquitoes in 1945 when the lighter DDT application was made.

INSPECTION RECORDS

In table II the inspection records of both sprayed and unsprayed houses are

summarized and arranged to show the number of houses inspected on premises having various densities of *quadrимaculatus*, as indicated by the number of *Anopheles* occurring in favorable unsprayed resting places on the premises, and the percentage of houses harboring these mosquitoes in each of these density groups. Included in this table are records of inspections of the 21,951 sprayed and of 1,639 unsprayed houses. The latter show the extent of normal house infestation in the presence of the various *quadrимaculatus* densities. For both sprayed and unsprayed areas, houses were considered *quadrимaculatus* positive only when mosquitoes were found in them during the afternoon. However, houses found negative in the morning have been presumed to be negative in the afternoon also. The data clearly indicate the effectiveness of the spray in keeping premises free of resting mosquitoes. As might be expected, as the densities of mosquitoes about premises increase, the percentage of houses with mosquitoes also increases to a slight extent.

Selection of areas for residual spray operations has been based on malaria rates



Spraying walls of rural schools.

rather than on *quadrимaculatus* densities. However, it is of interest that of the 21,951 sprayed houses inspected, 6,995 or 32 percent were in areas having premise densities in the groups above 10, while of the 1,639 unsprayed houses inspected only 241 or 15 percent were in this category; thus, indicating that in those areas in which residual spray work has been carried on, that is, in the more malarious areas, *Anopheles* densities are in general higher than in areas not selected for the work.

Table II

HOUSE INSPECTIONS ON RESIDUAL SPRAY PROGRAM

NUMBER OF HOUSE INSPECTIONS IN VARIOUS *QUADRIMACULATUS* DENSITY GROUPS IN SPRAYED AND UNSPRAYED AREAS AND PERCENT OF AFTERNOON *QUAD.*-POSITIVE HOUSES

| | NATURAL RESTING PLACE <i>QUADRIMACULATUS</i> DENSITIES | | | | | | |
|--------------------------|--|-------|--------|---------|---------|------|-------|
| | 0-10 | 11-50 | 51-100 | 101-200 | 201-400 | 400- | All |
| Sprayed Areas | | | | | | | |
| No. houses inspected | 14956 | 4693 | 1151 | 561 | 348 | 242 | 21951 |
| No. with <i>A. quad.</i> | 79 | 63 | 28 | 17 | 13 | 20 | 220 |
| Percent | 0.5 | 1.3 | 2.4 | 3.0 | 3.7 | 8.3 | 1.0 |
| Unsprayed Areas | | | | | | | |
| No. houses inspected | 1398 | 177 | 34 | 9 | 12 | 9 | 1639 |
| No. with <i>A. quad.</i> | 99 | 77 | 13 | 7 | 6 | 6 | 208 |
| Percent | 7.1 | 43.5 | 38.2 | 777.8 | 50.0 | 66.7 | 12.69 |

The numbers of mosquitoes which have been found in sprayed houses during afternoon inspections have been small, averaging less than 2 mosquitoes per house for the 220 afternoon positive houses. Also, it is quite likely that not all of these mosquitoes will survive since we may assume that some of them will shift from a non-lethal to a lethal surface during the evening providing the house has been properly sprayed.

Concerning the reduction of *quadrimaculatus* positive houses from morning to afternoon, we have records of 175 sprayed houses in which a total of 318 mosquitoes were found during the morning. Upon reinspection during the afternoon, 124 of these houses were mosquito-free. Thus a reduction in positive houses from morning to afternoon of 71 percent occurred. In the remaining 51 houses in which mosquitoes survived until afternoon, a total of 97 mosquitoes was counted in the morning and 74 in the afternoon for a reduction of only 25 percent. No doubt the explanation for this persistence is that these houses were not adequately sprayed since it has been found that normally fewer mosquitoes are found inside houses in the afternoon than in the morning. The meager data we have on this point show such a reduction of about 13 percent.

Incomplete data on the results of the residual spray work in the selective killing of anophelines which have taken human blood meals as determined by precipitin tests show that of 25,798 specimens of *quadrimaculatus* collected on premises where the houses had been treated with DDT residual spray, only 40 or 0.2 percent had fed on humans, while of 6,509 specimens collected from premises where the houses were untreated, 74 or 1.1 percent had had human blood meals. This finding of 1.1 percent human feedings among the unsprayed premise specimens as against 0.2 percent among sprayed premise specimens is highly significant statistically. By chance, such a difference would be expected to occur in like samplings less than one time in 20 million.

These data indicate that the proportion of the *Anopheles* population containing human blood meals is 82 percent less around sprayed than around unsprayed premises. Of course, the effect of the spray work in lessening malaria can only be determined from epidemiological data. However, it may be concluded that the chance for malaria transmission in the sprayed areas has been greatly reduced as a result of this highly effective killing of human-fed *Anopheles*.

